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(54) Apparatus and method for ballast replacement

(57) The present invention provides apparatus for the continuous replacement of ballast material beneath a railway track comprising rails (10A, 10B), mounted on sleepers (11A, 11B). The apparatus comprises: (a) means to cut an elongate trench (12) adjacent one rail (10B) of the track and extending in a direction substantially parallel to said rail; (b) means (13) to remove ballast material from beneath one or more of the sleepers (11B) and to convey said ballast material to a collector means (14) located in said trench; (c) collector means (14) to collect said removed ballast material and to deposit it on a conveying means (15); (d) means (15) to convey the deposited collected ballast material to a disposal means; and (e) means to replace the removed ballast with fresh ballast; wherein at least said means (b) and (c) are in operative association with each other.

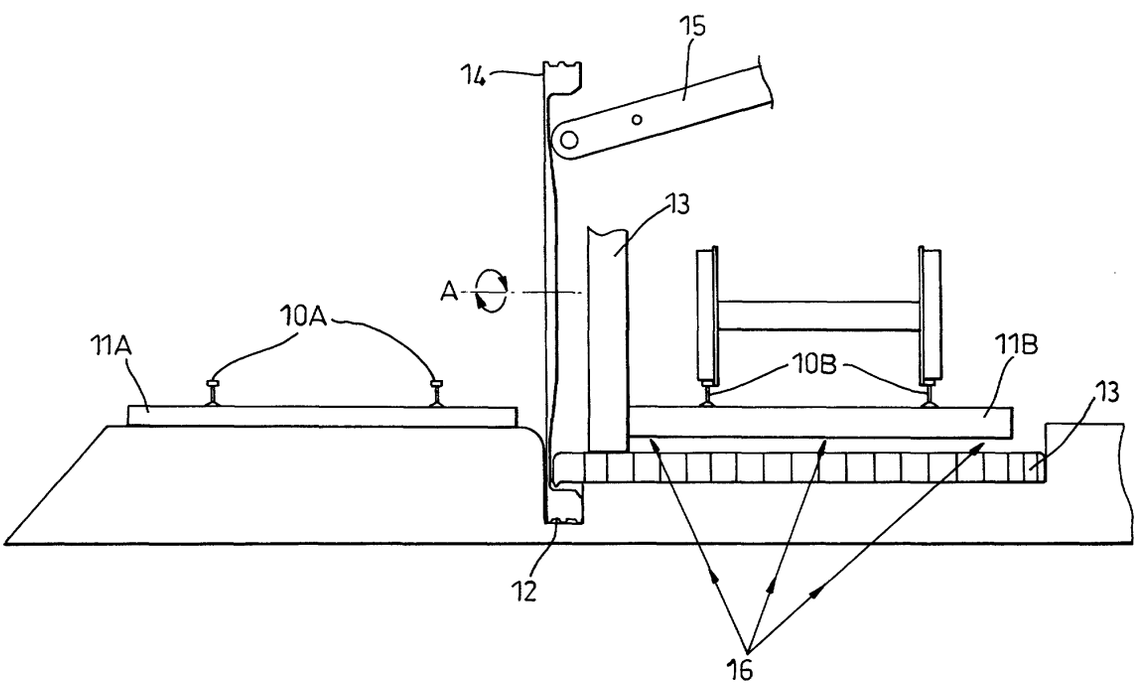

Fig. 1

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Description

[0001] This invention relates to an apparatus for the continuous replacement of ballast material beneath a railway track mounted on sleepers, to a ballast replacement train incorporating such apparatus and to a method of ballast replacement by means of such apparatus.

[0002] The ballast material beneath the sleepers of a railway track degrades over a period of time owing to the forces exerted by trains using the track. Moreover, if the ballast becomes wet (e.g. during inclement weather) it can effectively be formed into a slurry by the "pumping" action caused by movement of a train on the track. This leads to the formation of a so-called "wet-spot", necessitating the removal of the damaged ballast and replacement with fresh ballast.

[0003] Hitherto, damaged ballast has been replaced either by physically "digging out" from the affected area or by taking up the track and sleepers before using mechanical excavators. In both such methods it is necessary to close the railway line to traffic.

[0004] It has been proposed to provide means for replacing ballast without having to take up the track. One such known means comprises a machine which grinds away the damaged ballast from beneath the sleepers and removes the grinding residue by suction to a conveyor. However, it has been found that such a machine is substantially ineffective due to the compacted nature of the degraded ballast encountered in the United Kingdom.

[0005] It has also been proposed to cut a trench ahead of the excavation, the intention being that the excavated ballast falls into the trench for subsequent collection. Cutting of the trench has been attempted by means of a rotatable wheel having a plurality of scoops or buckets around its periphery. It has been found, however, that the scoops or buckets become clogged in use, with the result that the efficiency of the cutting machine is no greater than about 30% and a usable trench is not achieved.

[0006] It is an object of the present invention to provide apparatus for the continuous replacement of ballast, in which the above-mentioned disadvantages are minimised and efficient, cost-effective track maintenance is achieved.

[0007] Accordingly, in a first aspect, the present invention provides apparatus for the continuous replacement of ballast material beneath a railway track mounted on sleepers, the apparatus comprising:

(a) means to cut an elongate trench adjacent one rail of the track and extending in a direction substantially parallel to said rail;

(b) means to remove ballast material from beneath one or more of the sleepers and to convey said ballast material to a collector means located in said trench;

(c) collector means to collect said removed ballast material and to deposit it on a conveying means;

(d) means to convey the deposited collected ballast material to a disposal means;

(e) means to replace the removed ballast with fresh ballast;

in which at least said means (b) and (c) are in operative association with each other.

[0008] Suitably, at least said means (b), (c) and (d) are in operative association with one another.

[0009] Preferably, at least said means (b), (c), (d) and (e) are in operative association with one another.

[0010] Most preferably, all said means (a) to (e) are in operative association with one another.

[0011] In accordance with the present invention, the collector means (c), for collecting removed ballast material and depositing it on a conveying means, may comprise a rotatable member of generally circular transverse section having a plurality of collector members located about its periphery.

[0012] Thus, the collector means (c) may comprise a wheel having a plurality of scoops or buckets located about its periphery.

[0013] Alternatively, the collector means (c) may comprise a plurality of radiating spokes, each spoke having a scoop or a bucket located at its outermost end.

[0014] Suitably, each scoop or bucket may be provided with a "sharpened" leading edge to facilitate collection of the removal ballast.

[0015] The means (a) may suitably comprise a flat rotary cutter, for example a trenching arm of the standard type available within the civil engineering industry. In use, the means (a) creates an elongate trench adjacent to and substantially parallel with one of the rails. Suitably, the trench will be of a depth in the range 400 to 800 mm. When the means (a) is, in accordance with a particularly preferred embodiment of the present invention, in operative association with the means (b), (c), (d) and (e), it is desirable that the trench should extend by at least 4.5m ahead of the ballast removal/conveying means (b).

[0016] The means (b) may suitably comprise a chain-saw in operative association with a conveyor wheel, for example a chain-saw/conveyor of the type available from Kershaw as 42-4 track undercutter. In use, the means (b) excavates ballast from beneath one or more adjacent sleepers and conveys it to the collector means (c).

[0017] The means (d), for conveying ballast material (received from the collector means (c)) to a disposal means, may suitably comprise a conveyor belt or the like.

[0018] Alternatively, the means (d) may comprise a helical screw-conveyor (e.g. of a type known **per se**).

[0019] The means (e), for replacing the removed bal-

last with fresh ballast at the point of excavation, may suitably comprise one or more bottom discharge hoppers of the "self-discharge" type, which in use deliver fresh ballast directly to the rear of the cutting face by means of under-wagon conveyors.

[0020] Tamping and stabilisation means, (e.g. of a type known **per se**), may additionally be provided in operative association with means (a) to (e) of the apparatus according to the present invention.

[0021] In a second aspect, the present invention provides a ballast replacement train for use in the continuous replacement of ballast material beneath a railway track mounted on sleepers, the train comprising the apparatus according to the first aspect of the present invention, mounted on one or more rail-borne vehicles.
In a preferred embodiment of the second aspect of the present invention, the train may comprise:

(i) at least one locomotive;
(ii) at least one apparatus according to the first aspect of the present invention;
(iii) at least one wagon to receive excavated ballast; and
(iv) at least one wagon to contain replacement ballast;

with, optionally, at least one tamping means.

[0022] In accordance with standard railway maintenance practice, the train may further include at least one service/office wagon and at least one contingency wagon.

[0023] In a third aspect, the present invention provides a method for the continuous replacement of ballast material beneath a railway track mounted on sleepers, by means of apparatus according to the first aspect of the present invention, in which the method comprises the steps of:

(a) cutting an elongate trench adjacent one rail of the track and extending in a direction substantially parallel to said rail;

(b) removing ballast material from beneath one or more of said sleepers and conveying said ballast material to a collector means located in said trench;

(c) collecting said removed ballast material and depositing it on a conveying means;

(d) conveying the deposited collected ballast material to a disposal means; and

(e) replacing the removed ballast with fresh ballast, at least steps (b) and (c) being in operative association with each other.

[0024] Suitably, at least steps (b), (c) and (d) are in operative association with one another.

[0025] Preferably, at least steps (b), (c), (d) and (e) are in operative association with one another.

[0026] Most preferably, all of steps (a) to (e) are in operative association with one another.

[0027] The method in accordance with the present invention may further comprise tamping and stabilisation of the fresh ballast following step (e).

[0028] The present invention will be illustrated, merely by way of example, in the following description and with reference to the accompanying drawings.

[0029] In the drawings (wherein like numerals denote like parts):

Figure 1 is a schematic sectional view of part of an apparatus according to the first aspect of the present invention;

Figure 2 is a schematic view of a train according to the second aspect of the present invention, including the apparatus of Figure 1.

[0030] Referring to Figure 1, a railway track comprises two sets of rails 10A and 10B, mounted on sleepers 11A and 11B respectively. An elongate trench 12, adjacent to one of the rails of set 10B, extends substantially parallel thereto.

[0031] Undercutting and conveying means 13 acts, in use, to remove ballast from beneath the sleepers 11B and to convey it to the collector means 14.

[0032] The collector means 14 comprises a wheel provided with a plurality of scoops or buckets and rotating about its axis in the direction shown by arrows A. The means 14 collects ballast from the undercutting and conveying means 13 and deposits the collected ballast on to conveyor means shown schematically at 15. The collected ballast is conveyed thereafter to one or more spoil wagons (not shown).

[0033] Replacement ballast material is delivered, in the direction shown schematically at 16, to the rear of the cutting face. This serves to maintain the track in a substantially level condition during ballast replacement and to minimise the loss of cant.

[0034] Referring to Figure 2, the train according to the second aspect of the present invention comprises a ballast excavation apparatus 20 of the type illustrated in Figure 1, in operative association with spoil wagons 21 and 22, ballast wagons 23 and 24 and a tamper/stabiliser 25.

[0035] The train is drawn by a locomotive 26 and may include a service/office wagon 27 and one or more contingency wagons 28.

Claims

1. Apparatus for the continuous replacement of ballast material beneath a railway track mounted on sleepers (11A, 11B), the apparatus comprising:

(a) means to cut an elongate trench (12) adjacent one rail (10B) of the track and extending in a direction substantially parallel to said rail;

(b) means (13) to remove ballast material from beneath one or more of the sleepers (11B) and to convey said ballast material to a collector means (14) located in said trench;

(c) collector means (14) to collect said removed ballast material and to deposit it on a conveying means (15);

(d) means (15) to convey the deposited collected ballast material to a disposal means;

(e) means to replace the removed ballast with fresh ballast;

in which at least said means (b) and (c) are in operative association with each other.

2. Apparatus according to Claim 1, in which at least said means (b), (c) and (d) are in operative association with one another.

3. Apparatus according to Claim 1, in which at least said means (b), (c), (d) and (e) are in operative association with one another.

4. Apparatus according to Claim 1, in which all said means (a) to (e) are in operative association with one another.

5. Apparatus according to any one of Claims 1 to 4, in which the collector means (c) comprises a rotatable member of generally circular transverse section having a plurality of collector members located about its periphery.

6. Apparatus according to Claim 5, in which the collector means (c) comprises a wheel having a plurality of scoops or buckets located about its periphery.

7. Apparatus according to Claim 5, in which the collector means (c) comprises a plurality of radiating spokes, each spoke having a scoop or a bucket located at its outermost end.

8. Apparatus according to Claim 6 or 7, in which each scoop or bucket is provided with a "sharpened" leading edge.

9. Apparatus according to any one of Claims 1 to 8, in which the means (a) comprises a flat rotary cutter.

10. Apparatus according to any one of Claims 1 to 9, in which the means (b) comprises a chain-saw in operative association with a conveyor wheel.

11. Apparatus according to any one of Claims 1 to 10, in which the means (d) comprises a conveyor belt or the like.

12. Apparatus according to any one of Claims 1 to 10, in which the means (d) comprises a helical screw-conveyor.

13. Apparatus according to any one of Claims 1 to 12, in which the means (e) comprises one or more bottom discharge hoppers of the "self-discharge" type.

14. Apparatus according to any one of Claims 1 to 13, further including tamping and stabilisation means.

15. A ballast replacement train comprising an apparatus according to any one of Claims 1 to 14, mounted on one or more rail-borne vehicles.

16. A train according to Claim 15, comprising:

(i) at least one locomotive (26);
(ii) at least one apparatus (20) according to any one of Claims 1 to 14;
(iii) at least one wagon (21, 22) to receive excavated ballast; and
(iv) at least one wagon (23, 24) to contain replacement ballast;

with, optionally, at least one tamping means (25).

17. A train according to Claim 15 or 16, further including at least one service/office wagon (27) and at least one contingency wagon (28).

18. A method for the continuous replacement of ballast material beneath a railway track mounted on sleepers, by means of apparatus according to any one of Claims 1 to 14, in which the method comprises the steps of:

(a) cutting an elongate trench adjacent one rail of the track and extending in a direction substantially parallel to said rail;

(b) removing ballast material from beneath one or more of said sleepers and conveying said ballast material to a collector means located in said trench;

(c) collecting said removed ballast material and depositing it on a conveying means;

(d) conveying the deposited collected ballast material to a disposal means; and

(e) replacing the removed ballast with fresh ballast, at least steps (b) and (c) being in operative association with each other.

19. A method according to Claim 18, in which at least said steps (b), (c) and (d) are in operative association with one another.

20. A method according to Claim 18, in which at least said steps (b), (c), (d) and (e) are in operative association with one another.

21. A method according to Claim 18, in which all of steps (a) to (e) are in operative association with one another.

22. A method according to any one of Claims 18 to 21, further comprising tamping and stabilisation of the fresh ballast following step (e).

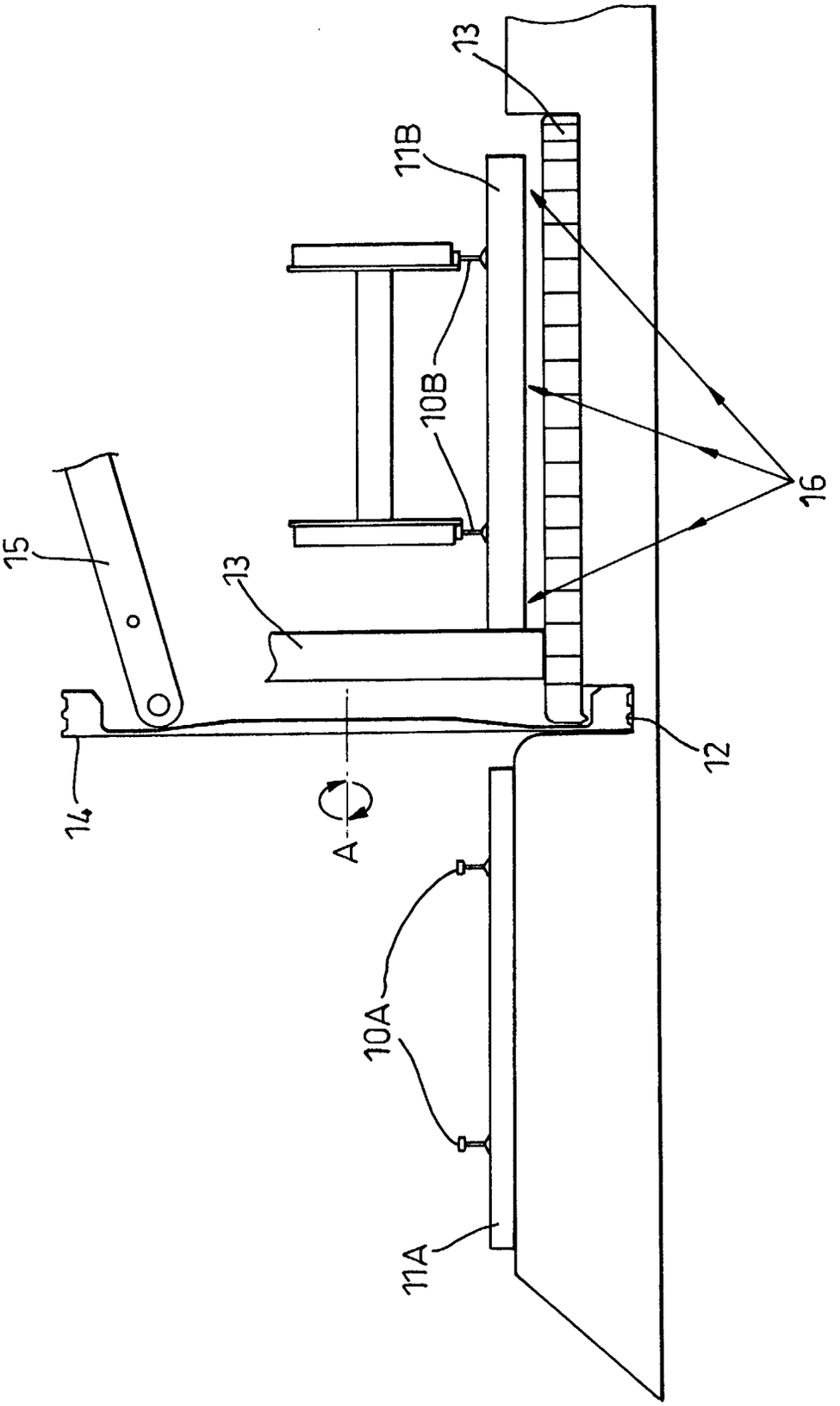

Fig. 1

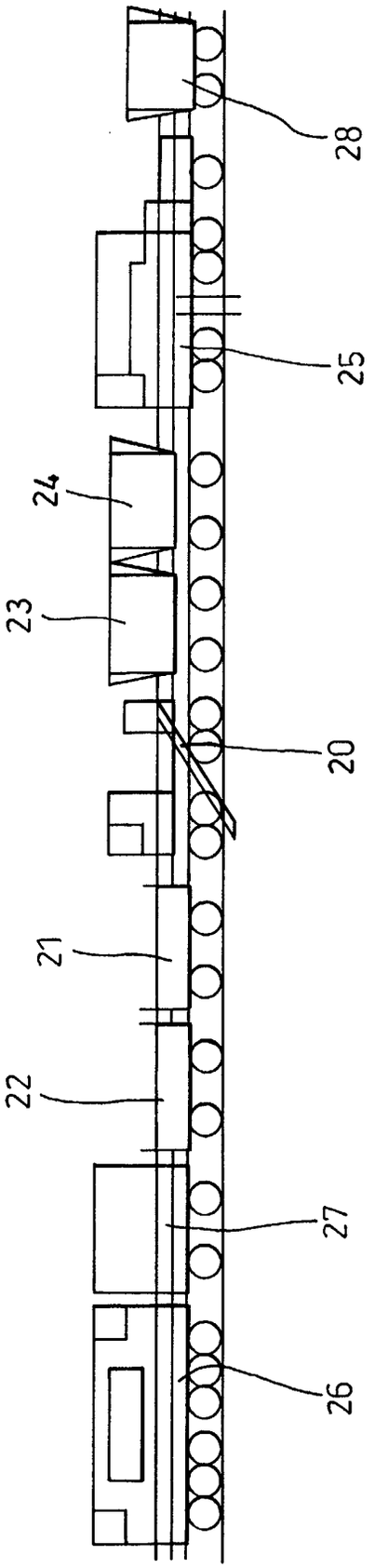

Fig. 2